

Is It a Polygon?

What Happens

Students place shapes in two categories, polygons and not polygons, using a few examples as references. They list attributes of a polygon and features a polygon cannot have. Students find the polygons in a representation of the shapes in a Cubist painting, and for homework make their own polygon pictures. Student work focuses on:

- working with two-dimensional shapes
- distinguishing between polygons and shapes that are not polygons
- drawing polygons

Materials

- Overhead projector
- Polygons and Other Figures (transparency)
- Student Sheet 1 (1 per pair)
- Chart paper
- Student Sheet 2 (transparency, and 1 per student, homework)
- Family letter (1 per student)

Activity

Display the transparency of Polygons and Other Figures on the overhead. After students have had a few minutes to consider the transparency, distribute Student Sheet 1, *Is It a Polygon?* to each pair of students. Using the information on the transparency, pairs sort the shapes into two categories: those that are polygons and those that are not. On each shape they write *yes* or *no* (or some other notation) to keep track of their decisions.

While the students are working, draw a large circle on the board in which they can sketch polygons, and label it *Polygons*. Label an area outside of the circle *Not Polygons*. When pairs have finished Student Sheet 1, introduce the activity.

We are going to play a silent game. You will take turns coming to the board to draw one of the shapes from your sheet. Draw the shape *inside* the circle if you think it is a polygon, *outside* if it is not. Everyone else will think about the shape you drew. Is it in the right place?

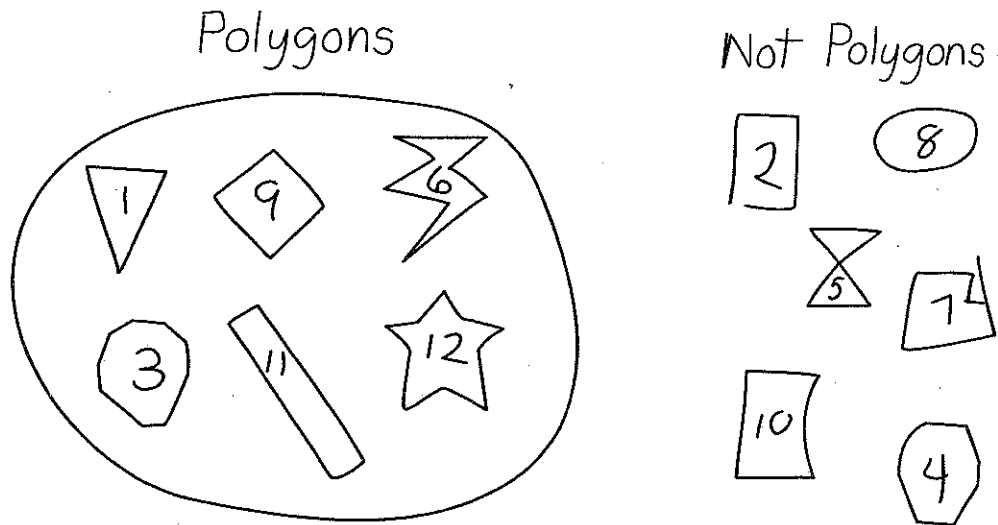
If you think a shape is in the wrong place, you may put a question mark near it when you come up for your turn, instead of drawing a new shape.

Each pair selects one representative to go *silently* to the board and draw a shape from Student Sheet 1 either inside or outside the circle, or put a question mark by a shape they think has been placed incorrectly. To emphasize the game's silence, you might gesture to indicate turns instead of calling names.

Picking Out Polygons

Once all the shapes have been placed, allow some time to discuss the placements. Disagreements offer particularly good opportunities for students to explain and defend their reasoning about what qualifies as a polygon.

Unless there are several disagreements, there will probably not be enough shapes for each pair to draw one on the board. If there are students who do not get a chance in this activity, ask them to offer their thoughts at the beginning of the next one.



Activity

Defining a Polygon

In the silent drawing game, students *showed* their developing sense of what a polygon is and is not. Now help them verbalize that sense by asking them to describe the attributes of a polygon.

For a shape to be a polygon, what must be true? What cannot be true?

List students' ideas on chart paper. You might want to begin two sentences and ask students to finish them, for example, "Polygons *must* have..." and "Polygons *cannot* have..." The **Dialogue Box**, Describing Polygons (p. 8), illustrates the list one class compiled.

As an extension, suggest that students write their own definition of a polygon.

Activity

Polygon Art

Save the last few minutes of the session to introduce the homework: drawing a picture made up entirely of polygons. Display the transparency of Student Sheet 2, Picasso's Polygons, on the overhead. Briefly explain that in the style of art we call *cubism*, artists like Pablo Picasso represented people and objects by breaking them down into many flat shapes.

This picture shows the shapes in a drawing done by Picasso in 1918, *Woman in an Armchair*. (The original drawing includes some curved lines; all are represented by straight lines here to emphasize the polygonal forms.) If possible, show prints of other cubist works by Picasso.

Discuss what various polygons in the drawing might represent. Some students may comment that the picture as a whole is not a polygon because of the many interior lines. Acknowledge that they are correctly applying the definition of a polygon, and redirect their attention to the smaller polygons that make up the whole picture.

Do you notice any shapes you think are *not* polygons?

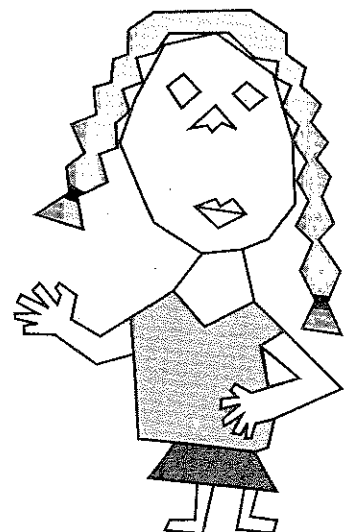
Many students say that the larger shapes surrounding the eyes in the picture are not polygons because they have other shapes in the middle (the eyes). Decide as a class what rules to follow in their own drawings.

Session 1 Follow-Up

Picasso's Polygons Send home the family letter or the *Investigations* at Home booklet. In addition, students take home their own copy of Student Sheet 2, Picasso's Polygons. Students may draw their own picture on the back. Suggest that they try drawing some things that have natural curves, such as people, animals, or plants. Encourage students to use polygons with many different numbers of sides, not just triangles and quadrilaterals. Suggest that they work in pencil so they can erase, and remind them to follow the rules for polygons.



Homework



Describing Polygons

These students are describing attributes that make a figure a polygon. The teacher is recording some of their ideas on a list.

Antonio: It can't be a circle or have curved lines.

[Teacher writes: It can't have curved lines.]

Trevor: Yeah, it has to have corners or points.

[Teacher writes: It has corners (vertices).]

Shakita: Do they have to have four or more sides?

Based on the polygons we've seen, is that a reasonable attribute?

Heather: Is a triangle a polygon?

Cara: Yes, we should make it less. Two or more sides.

Duc: I never heard of a shape that has two sides.

Cara: OK, three or more sides.

[Teacher writes: It has three or more sides.]

What other properties does a polygon have to have?

Toshi: They have to have a line all the way around.

[Tracing the outline of one of the polygons] This is called a **closed shape**. What do you think that means?

Alani: There's no open place at the edge. It's like a dog inside a fenced yard.

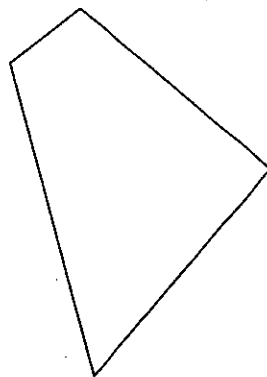
[Teacher writes: It is a closed shape.]

Matt: Another thing is it doesn't cross over. The lines can't meet in the middle.

Maricel: I know what you mean. It can't be an 8 shape. It only has one space in it.

We call it a **simple shape**. It is just one space.

Greg: Cut them in half and they're even. Like it has to be the same after you fold it. If you fold it in half and if it's the same shape still, then it's a polygon.



What about this shape?

What do others think? Does a polygon need to fold in half exactly?

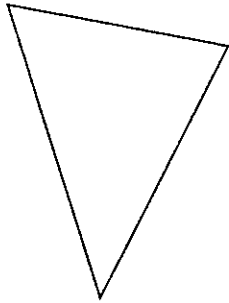
Natalie: No, it can be weird and still be a polygon.

The class ends up with the following list:

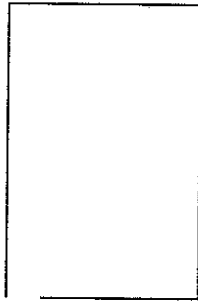
✱	Polygons
Must be true:	Cannot be true:
■ It has only straight sides.	■ It doesn't cross over.
■ It has three or more sides.	■ It can't have curved lines or be a circle.
■ It has corners (vertices).	■ It can't have more than one space in it.
■ Lengths of sides don't have to be equal.	
■ It is a closed shape.	
■ It doesn't have to be a typical shape (like a square or rectangle) or a symmetrical shape that can be folded in half exactly.	

Is It a Polygon?

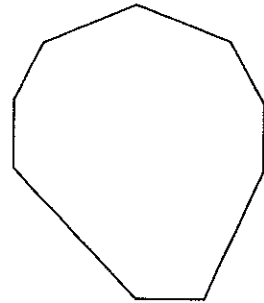
1.



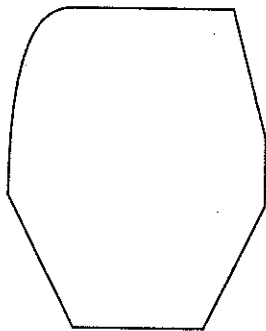
2.



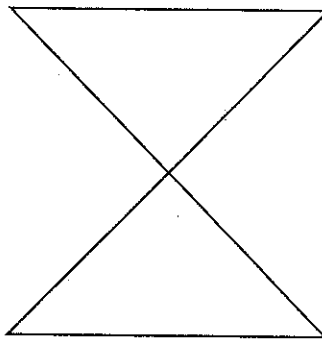
3.



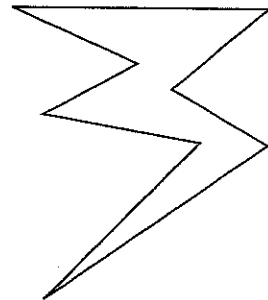
4.



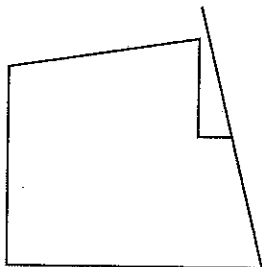
5.



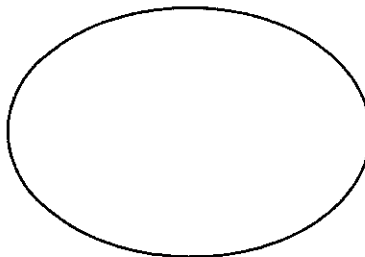
6.



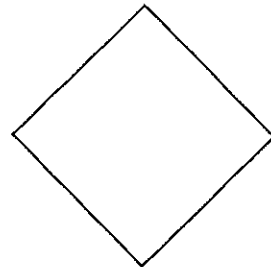
7.



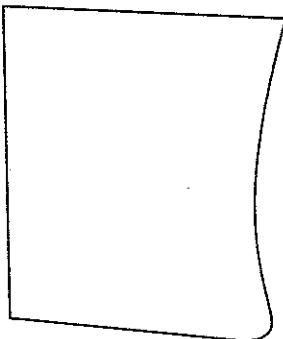
8.



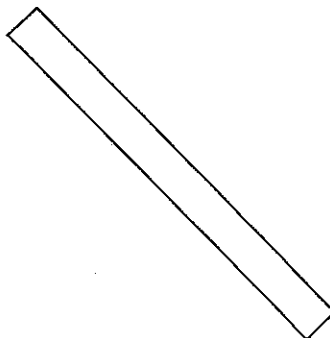
9.



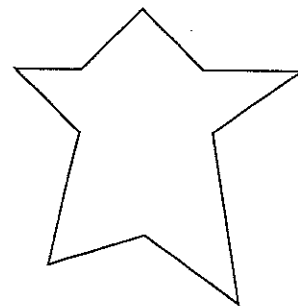
10.



11.

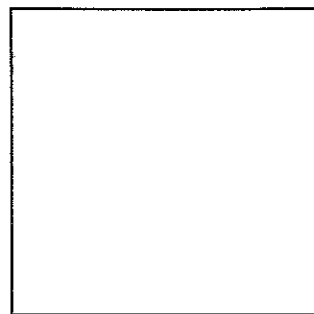
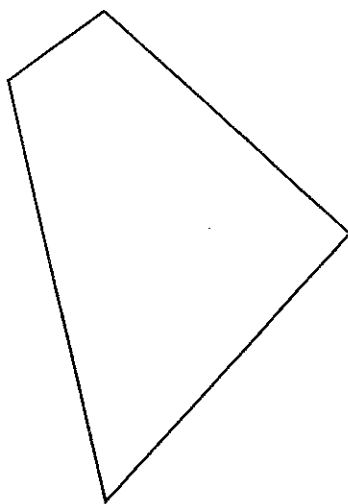
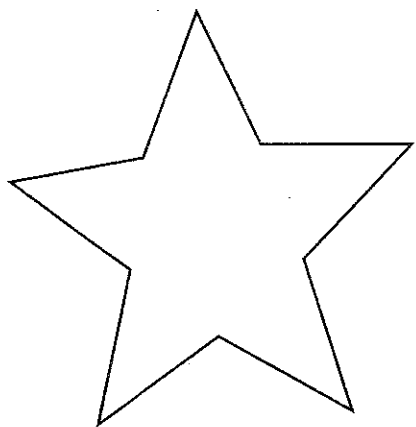


12.

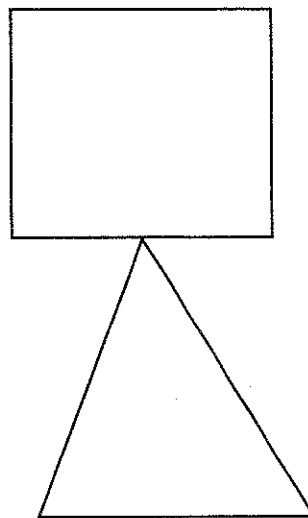
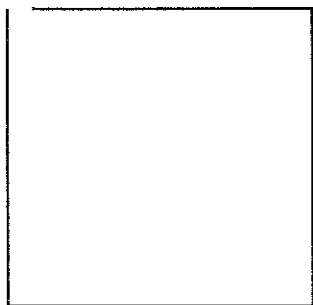
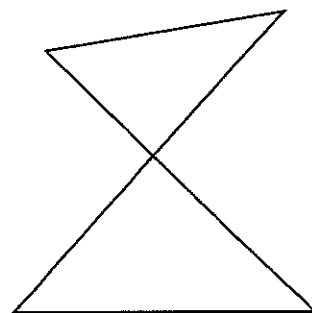
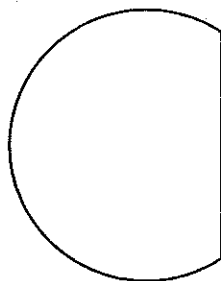
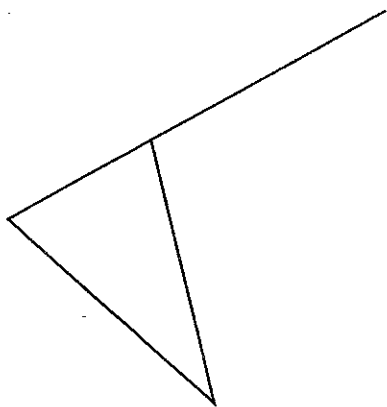


POLYGONS AND OTHER FIGURES

These are polygons.



These are not polygons.



Is Every Square a Rectangle? Is Every Rectangle a Square?

Answer the following questions, and draw sketches to illustrate your ideas.

Is every square a rectangle? Why or why not?

Is every rectangle a square? Why or why not?

Name _____

Identify Polygons

Essential Question How can you use line segments and angles to make polygons?

COMMON CORE STANDARD CC.3.G.1
Reason with shapes and their attributes.

CONNECT In earlier lessons, you learned about line segments and angles. In this lesson, you will see how line segments and angles make polygons.

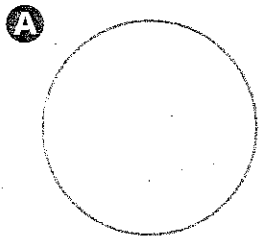
A **polygon** is a closed plane shape that is made up of line segments that meet only at their endpoints. Each line segment in a polygon is a **side**.

Math Idea

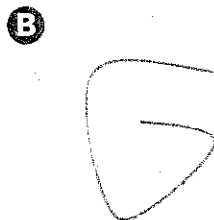
All polygons are closed shapes. Not all closed shapes are polygons.

UNLOCK the Problem REAL WORLD

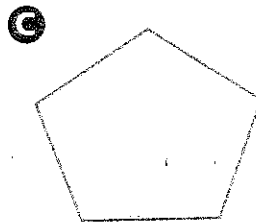
Circle all the words that describe the shape.



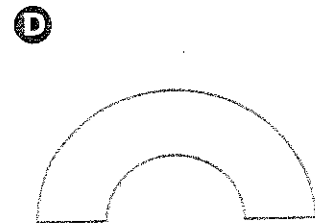
plane shape
open shape
closed shape
curved paths
line segments
polygon



plane shape
open shape
closed shape
curved paths
line segments
polygon



plane shape
open shape
closed shape
curved paths
line segments
polygon



plane shape
open shape
closed shape
curved paths
line segments
polygon

Try This!

Fill in the blanks with *sometimes*, *always*, or *never*.

Polygons are _____ plane shapes.

Polygons are _____ closed shapes.

Polygons are _____ open shapes.

Plane shapes are _____ polygons.

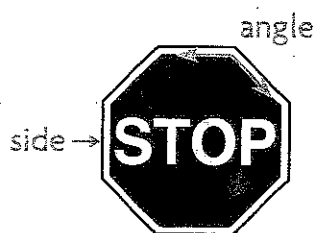
Math Talk

MATHEMATICAL PRACTICES

Explain why not all closed shapes are polygons.

Name Polygons Polygons are named by the number of sides and angles they have.

Some traffic signs are in the shape of polygons. A stop sign is in the shape of which polygon?

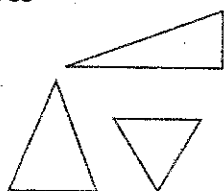


Count the number of sides and angles.

triangle

3 sides

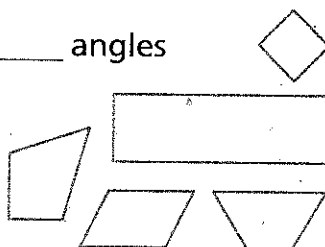
3 angles



quadrilateral

4 sides

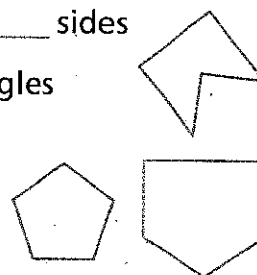
_____ angles



pentagon

_____ sides

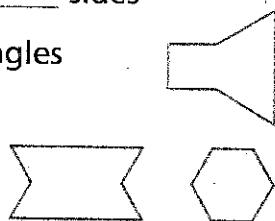
5 angles



hexagon

_____ sides

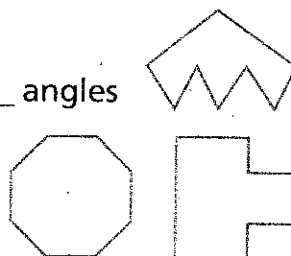
6 angles



octagon

8 sides

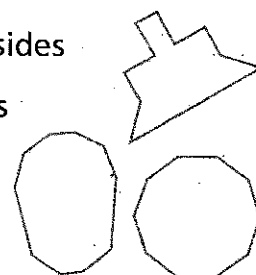
_____ angles



decagon

_____ sides

10 angles



How many sides does the stop sign have? _____

How many angles? _____

So, a stop sign is in the shape of an _____.

Math Talk

MATHEMATICAL PRACTICES

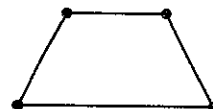
Compare the number of sides and angles. What is a true statement about all polygons?

Share and Show



1. The shape at the right is a polygon. Circle all the words that describe the shape.

plane shape open shape closed shape pentagon
curved paths line segments hexagon quadrilateral



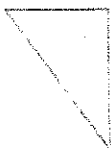
Name _____

Is the shape a polygon? Write *yes* or *no*.

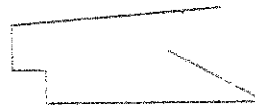
2.



3.



4.



MATHEMATICAL PRACTICES

Math Talk

Explain how you can change the shape in Exercise 4 to make it a polygon.

Write the number of sides and the number of angles. Then name the polygon.

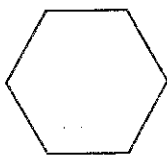
5.



_____ sides

_____ angles

6.



_____ sides

_____ angles

7.



_____ sides

_____ angles

On Your Own

Is the shape a polygon? Write *yes* or *no*.

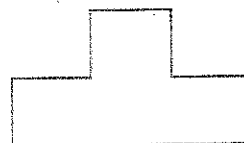
8.



9.



10.



Write the number of sides and the number of angles. Then name the polygon.

11.



_____ sides

_____ angles

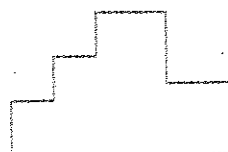
12.



_____ sides

_____ angles

13.

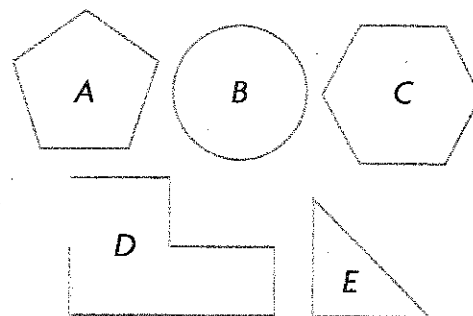


_____ sides

_____ angles

Problem Solving.....

14. **Write Math** **Sense or Nonsense?** Jake said Shapes A–E are all polygons. Does this statement make sense? **Explain** your answer.



15. **What if** Kim wants to draw a polygon? How can she check her drawing?

16. I am a closed shape made of 6 line segments. I have 2 angles less than a right angle and no right angles. What shape am I? Draw an example in the workspace.

17. **HO!** Is every closed shape a polygon? Use a drawing to help **explain** your answer.

18. **What's the Error?** Eric says that the shape at the right is an octagon. Do you agree or disagree?

Explain.



19. **★ Test Prep** Alicia drew the polygon at the right. What is the name of the polygon she drew?

- (A) octagon (C) pentagon
(B) hexagon (D) quadrilateral

